Cable Agreement Compliance
Audit Three of Three

March 10, 1999

Prepared for:
Steve Holmes, Director
Office of Cable Communications
618 Second Avenue, 12th Floor
Seattle, WA 98104

Prepared by:
Lisa DiMartino, Principal
Market Research and Analysis
8214 Linden Avenue North
Seattle, WA 98103

Table of Contents

Section   Page

1. Executive Summary

This audit evaluates AT&T Corporation's (AT&T), formerly TCI of Washington, Inc. (TCI), compliance with the original franchise agreement between the City of Seattle (the City) and AT&T and the franchise extension ordinance no. 119183. A technical evaluation and a service availability evaluation were conducted for Magnolia, Queen Anne, South Seattle and Madison Park on January 5th and February 17th, 2000. A follow-up technical evaluation was also completed for four West Seattle nodes and two Green Lake nodes.

The audit verifies that customers in Magnolia, Queen Anne, South Seattle and Madison Park currently have access to both expanded programming and cable modem services as defined in the extension ordinance. Expanded programming for video and @Home services was confirmed through both an engineering audit of the fiber optic nodes and by customer interviews.

The auditors have reviewed internal node activation reports produced by AT&T to confirm the number of customers activated each month from January through December 1999. Our evaluation provides evidence that AT&T completed construction and activation plans ahead of schedule to currently serve about 56,045 customers. The engineering evaluation shows that AT&T's upgraded system provides a minimum of 70 analog channels within the 54 to 750 MHz spectrum. However, the spectrum test results show distortion at some nodes and a missing audio signal at other nodes. Transmission tests, conducted by timing large file downloads, show that @Home is faster than traditional dial-up service and faster than Digital Subscriber Line (DSL) service.

AT&T still has not provided a measurement of contention as indicated in the franchise agreement. AT&T maintains that customers always have access to the service as long as the network is up.

A service activation evaluation conducted by interviewing AT&T customers shows that customers have access to expanded services. However, the interviews show mixed results in terms of the quality of those services and customer satisfaction. While the results are mostly satisfactory, a significant portion of customers is not satisfied with the current level of service. Video quality and customer service problems were the biggest issues for cable TV subscribers. Access to e-mail and customer service problems were the biggest issues for @Home subscribers.

2. Introduction

This is the third of three audits performed to determine AT&T's compliance with the requirements of their cable television franchise agreement and franchise extension ordinance no. 119183. This audit evaluates the upgrade of AT&T's network to accommodate 70 channels within the 54 to 750 MHz spectrum and to offer high-speed Internet access throughout areas currently upgraded, as specified in both the original 1996 franchise agreement, and the franchise extension ordinance that took effect last year. The audit evaluates traditional video services as well as @Home services for Queen Anne, Magnolia, South Seattle and Madison Park build areas.

This audit consists of both a technical evaluation of the AT&T network and a service evaluation of AT&T customers. The technical evaluation includes certification review, node testing and network reliability and performance, while the service evaluation involves interviewing AT&T customers to determine access to service and customer satisfaction. The technical evaluation is detailed in Sections 3 and 4. The service availability evaluation is detailed in Section 5.

Technical Evaluation

The auditors reviewed the certifications received by the City of Seattle from AT&T confirming node activation from January 1999 through December 1999.

Technical evaluations of the nodes were performed on January 5th, 6th, and 20th, 2000 and February 1st, and 15th, 2000. Nodes were randomly chosen to represent the general population of each area. Four nodes were tested in the West Seattle and Alki build areas for @Home transmission rates of 1.5 Mbps[1] and 96 Kbps for downstream and upstream, respectively. Ten nodes in Green Lake, Queen Anne/Magnolia, South Seattle and Madison Park build areas were tested for channel capacity and @Home transmission rates.

A performance evaluation was finalized during Audit Two to determine the network configuration and to evaluate network redundancies, fiber protection and power supply.

---

[1] Megabits per second and kilobits per second

Both the certification review and the reliability and performance evaluations were based on data obtained from AT&T's maintenance records.

Service Availability Evaluation

The service availability portion of this audit assesses whether or not AT&T offers additional cable television channels and high-speed Internet service to customers in the areas studied. It also assesses customer satisfaction for each service. The evaluation was conducted through a customer telephone survey completed between February 5th and February 18th with thirty AT&T cable TV and @Home customers[2]. Twenty-three interviews were completed for cable TV and twenty-four were completed for @Home. Customers subscribe to expanded basic cable service and/or the @Home Internet Service.

The purpose of the survey was to determine whether customers subscribing to AT&T's expanded basic package have access to 70 programming channels and whether customers have access to the Internet through the @Home service. It also rates the quality of programming and functionality of the cable TV service and the speed and functionality of the @Home service. In addition to determining access to service and quality of service, the survey results indicate the level of customer service satisfaction in terms of professionalism and knowledge of AT&T and @Home's customer service staff.

---

[2] Although the survey results reflect trends in service availability and customer satisfaction, the results taken from a small sample size of 30 are qualitative and therefore not statistically significant.

3. Certification

3.1 Network Status

The network infrastructure description determined in the second audit is maintained in this audit. The certification section in this audit provides a complete description of the network.

3.1.1 Infrastructure

Cable uses a sophisticated network of technologies that effectively combines point-to-point microwave, satellites, and fiber optic and coaxial cables. In order to provide an understanding of the network architecture and functionality, as well as descriptions of various individual elements that are deployed in AT&T's network, an overview of the functional configuration of the AT&T network is given in Figure 1.

There are two headends within the Seattle network that serve the City of Seattle and the greater Seattle area. The main headend in Burien is linked to the Roosevelt headend by the primary fiber ring. The primary ring consists of two self-healing fiber rings. Aerial and underground fiber cables are installed between the hub and the nodes. From the nodes, coaxial cables are connected to the customer premises. The cables are in satisfactory condition as evaluated one year after installation.

The Burien headend serves West Seattle with forty-seven local nodes and the secondary hubs within King County. As the main headend, it connects the following:

- 153 Satellite channels
- 13 Off-Air channels
- 9 Local Access channels
- IP routing to California

The second headend at Roosevelt connects eight hubs within the City of Seattle network with approximately 203 nodes each serving an average 1,200 homes.

3.1.1.1 Headend

The Burien headend houses the electronics equipment for the cable television system and @Home Internet services. Signals from broadcast transmissions, satellites and local television studios are received and processed at the system headend.

The Burien headend receives TV and IP signals via various transmission media (satellite, off-air and local access fiber) and coverts them to optical signals, which can be sent over fiber. To deliver digital data, the headend controller modulates the IP packets, encodes them as a digital signal and transmits the signal down the cable on an unused channel above the TV channels. AT&T's Internet services feed in using IP routing from California.

Satellite

[insert figure 1 network diagram]

Satellite dish

Off-Air

@home Service

IP Routing to

Local Access and Programming Facilities

Video

FSA

HEADEND BURIEN

West Seattle 47 Local

King County Secondary

Primary Fiber Ring

HEADEND ROOSEVELT

Secondary Fiber Ring

Secondary Fiber Ring

MP HU

LCE HU

LC W

Secondary Fiber Ring

GL HU

UE HU

QA HU

SS HU

NO DEs

NO DEs

UW HU

NO DEs

NO DEs

NO DEs

NO DEs

NO DEs

NO DEs

Figure 1
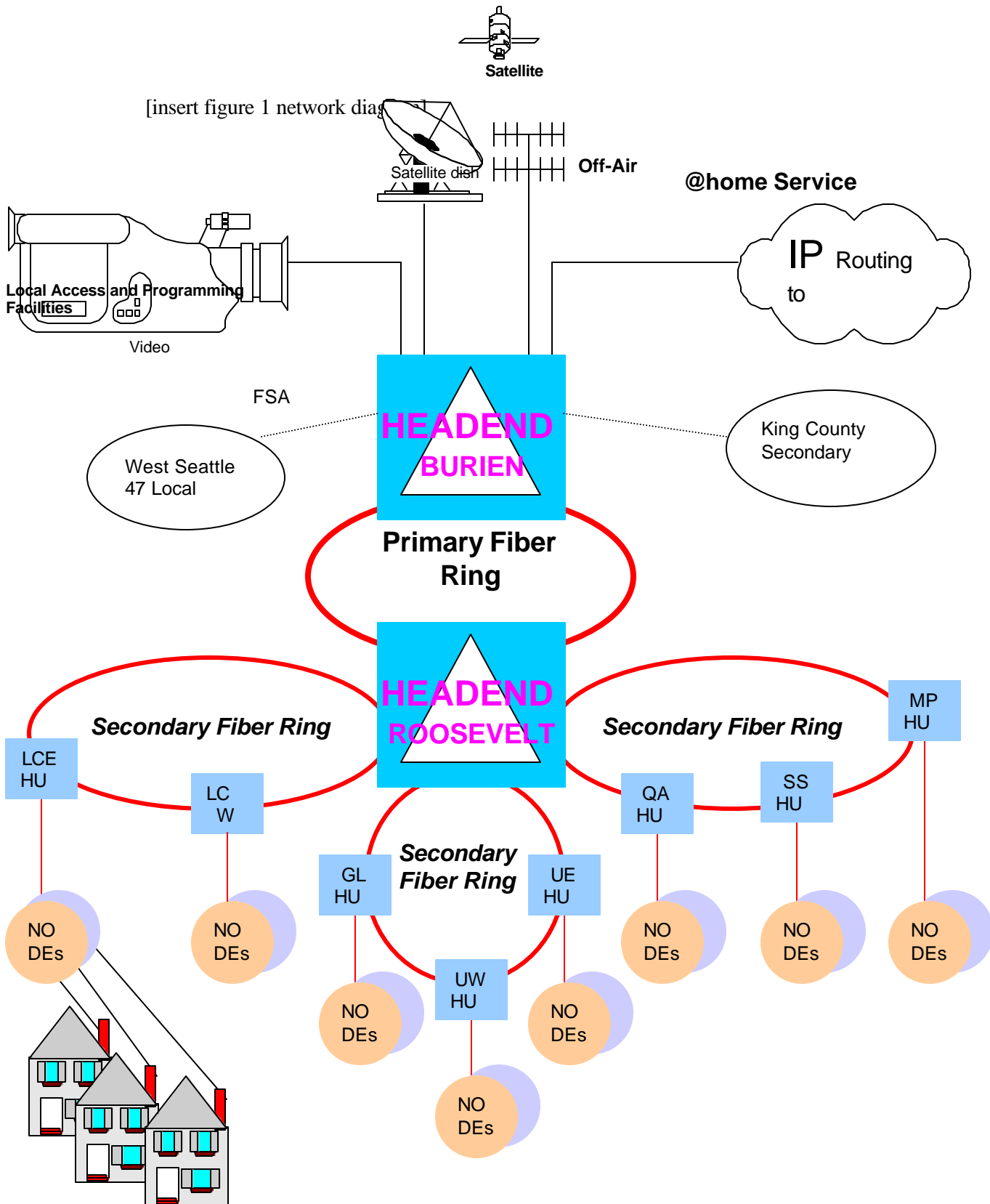
3.1.1.2 Hybrid Fiber & Coax (HFC)

AT&T deploys HFC grid to deliver both cable television (CATV) and Internet services, and has installed considerable new aerial fiber optic cables on poles throughout Seattle. Fiber optic cables are the main trunk cables, with coaxial cable reaching into homes from the nodes.

3.1.1.3 Node

To send television signals and data over an HFC network, laser transmitters convert signals sent from the headend into optical signals. This conversion occurs in node boxes which are usually attached to poles and are environmentally protected. At various points within the network, close by the residences or businesses, laser receivers at each node reconvert the optical signals into electrical signals.

3.1.1.4 Customer Premises

At a customer's premises, a cable splitter is installed. The cable splitter enables connection to both the computer's cable modem and the TV set.

3.1.2 Complete City of Seattle Build Area

Table 1 summarizes the number of customers that have been activated for the nodes throughout the City of Seattle. Tables 2 through 8 show the statistics of each node including the number of new customers reached by each node for each build area.

Table 1: Customers Activated

Build Area	No. of nodes	No. of homes passed	No. of customers	Construction complete date	Activation date
West Seattle	47	23,981	15,595	10/1/96	7/7/98-8/11/98
Alki	11	10,822	6,812	10/31/98-12/18/98	11/11/98-3/9/99
Green Lake	46	40,188	22,762	2/21/99-5/21/99	3/16/99-6/3/99
Queen Anne, Magnolia	23	24,066	15,003	5/1-8/16/99	5/18-9/1/99
Madison Park	25	26,325	12,104	9/13/99	9/14/99
South Seattle	8	7,000	4,333	6/15/99	6/17/99
Georgetown	2	649	369	7/21/99	8/12/99
Total[3]	**162**	**133,031**	**76,978**		

---

[3] Six downtown nodes DT1- DT6 are not included in totals

Table 2: West Seattle

Node	No. of homes passed	No. of customers	Construction complete date	Activation date	Comments
WS01	311	235	10/1/96	8/4/98	
WS02	603	452	10/1/96	7/14/98	Tested
WS03	424	267	10/1/96	8/4/98	
WS04	320	243	10/1/96	8/4/98	
WS05	583	378	10/1/96	8/4/98	
WS06	498	402	10/1/96	8/4/98	
WS07	601	496	10/1/96	8/4/98	
WS08	545	381	10/1/96	8/4/98	
WS09	561	346	10/1/96	8/4/98	
WS10	478	318	10/1/96	8/4/98	
WS11	481	330	10/1/96	8/4/98	
WS12	557	322	10/1/96	7/28/98	
WS13	533	341	10/1/96	7/28/98	Tested
WS14	557	387	10/1/96	7/28/98	
WS15	703	432	10/1/96	7/28/98	
WS16	504	359	10/1/96	7/28/98	
WS17	270	207	10/1/96	7/21/98	
WS18	544	416	10/1/96	7/21/98	
WS19	394	284	10/1/96	7/28/98	
WS20	532	310	10/1/96	7/21/98	
WS21	616	419	10/1/96	7/21/98	Tested
WS22	578	397	10/1/96	8/4/98	
WS23	616	296	10/1/96	7/14/98	
WS24	548	313	10/1/96	7/14/98	
WS25	654	348	10/1/96	8/11/98	
WS26	599	407	10/1/96	8/11/98	
WS27	748	565	10/1/96	8/11/98	
WS28	496	314	10/1/96	8/11/98	
WS29	490	320	10/1/96	8/11/98	Tested
WS30	449	288	10/1/96	8/11/98	
WS31	446	280	10/1/96	8/11/98	
WS32	543	302	10/1/96	8/11/98	
WS33	576	216	10/1/96	7/21/98	
WS34	517	653	10/1/96	8/11/98	
WS35	454	274	10/1/96	8/11/98	
WS36	573	372	10/1/96	7/14/98	
					Missing
WS38	489	292	10/1/96	7/14/98	
					Missing
WS40	571	326	10/1/96	8/11/98	
WS41	457	299	10/1/96	8/11/98	
WS42	316	203	10/1/96	7/14/98	
WS43	470	254	10/1/96	7/21/98	
WS44	476	248	10/1/96	7/14/98	
WS45	500	303	10/1/96	7/14/98	
WS46	229	136	10/1/96	7/21/98	
WS47	399	210	10/1/96	7/14/98	
WS48	484	247	10/1/96	7/7/98	Tested
WS49	588	407	10/1/96	7/7/98	
Total	**23,881**	**15,595**			

Table 3: Alki

Node	No. of homes passed	No. of customers	Construction complete date	Activation date	Comments
WS56	140	86	10/31/98	11/11/98	
WS57	711	447	10/31/98	11/18/98	
WS58	1277	799	11/10/98	11/19/98	
WS59	632	443	12/18/98	3/9/99	
WS60	1331	745	11/10/98	11/18/98	
WS61	757	498	11/10/98	11/11/98	Tested
WS62	1249	727	11/10/98	11/19/98	
WS63	1258	768	11/10/98	11/18/98	Tested
WS64	941	621	11/10/98	11/19/98	
WS65	1246	832	11/5/98	11/11/98	
WS66	1280	846	11/5/98	11/11/98	
Total	**10,822**	**6,812**			

Table 4: Green Lake

Node	No. of homes passed	No. of customers	Construction complete date	Activation date	Comments
GL16	1193	714	2/28/99	3/16/99	Tested
GL17	1179	730	2/28/99	3/16/99	
GL18	1252	807	2/28/99	3/16/99	Tested
GL19	1166	740	2/28/99	3/16/99	
GL20	1036	722	2/28/99	3/16/99	Tested
GL21	1319	712	2/28/99	3/16/99	
GL22	1015	590	2/28/99	3/16/99	
GL23	1165	612	2/28/99	3/16/99	
GL24	939	503	1/29/99	3/16/99	
GL25	1102	661	2/28/99	3/16/99	
GL26	1127	591	2/28/99	3/16/99	Tested
GL27	763	417	2/28/99	3/16/99	Tested
GL28	1077	565	1/29/99	3/16/99	
GL29	1175	579	1/29/99	3/16/99	
GL30	783	398	1/29/99	3/16/99	Tested
GL31	420	332	4/21/99	4/27/99	Tested
GL32	993	582	4/21/99	4/27/99	
GL33	773	440	4/21/99	4/27/99	
GL34	835	626	4/21/99	4/27/99	
GL35	1124	564	4/15/99	4/15/99	
GL36	1026	536	3/31/99	4/15/99	
GL37	853	403	9/31/99	4/15/99	
GL38	1140	518	3/31/99	4/15/99	
GL 39	1150	570	3/31/99	4/15/99	Tested
GL40	1155	561	3/31/99	4/15/99	
GL 41	1127	480	3/31/99	4/15/99	Tested
GL42	1127	617	4/2/99	4/15/99	
GL43	603	343	4/2/99	4/15/99	
GL44	819	389	4/20/99	4/22/99	
GL45	1107	502	3/31/99	4/15/99	
GL46	421	187	4/20/99	4/22/99	Tested
GL47	497	218	4/20/99	4/22/99	

Node	No. of homes passed	No. of customers	Construction complete	Activation date	Comments
GL48	858	432	4/20/99	4/22/99	
GL49	768	396	4/20/99	4/22/99	
UW15	434	322	5/14/99	5/18/99	
UW16	537	382	5/14/99	6/3/99	
UW17	340	211	5/14/99	6/3/99	
UW18	674	400	5/21/99	6/3/99	Tested
UW19	847	543	5/21/99	6/3/99	
UW20	604	464	5/14/99	5/18/99	
UW21	599	325	5/21/99	6/3/99	
UW22	584	414	5/21/99	6/3/99	
UW23	790	595	5/14/99	5/18/99	
UW24	573	397	5/21/99	6/3/99	
UW25	436	272	5/21/99	6/3/99	
UW26	583	400	5/21/99	6/3/99	
Total	**40,188**	**22,762**			

Table 5: Queen Anne, Magnolia

Node	No. of homes passed	No. of customers	Construction complete	Activation date	Comments
MG01	1439	940	05/26/1999	06/10/1999	Tested
MG02	865	577	05/26/1999	06/10/1999	
MG03	898	578	08/16/1999	08/17/1999	
MG04	1107	782	08/30/1999	09/09/1999	
MG05	961	606	08/30/1999	09/09/1999	
MG06	1220	768	08/30/1999	09/09/1999	
MG07	1399	837	06/30/1999	07/13/1999	
MG08	796	498	06/30/1999	07/13/1999	
MG09	767	540	06/30/1999	07/13/1999	
MG10	1248	1241	08/16/1999	08/17/1999	Tested
QA11	1047	675	05/13/1999	05/18/1999	
QA12	1284	758	06/25/1999	07/13/1999	Tested
QA13	1218	807	05/13/1999	05/18/1999	
QA14	1115	511	06/21/1999	07/13/1999	
QA15	1279	721	06/21/1999	07/13/1999	
QA16	950	530	06/21/1999	07/13/1999	
QA17	785	510	06/21/1999	07/13/1999	
QA18	909	456	06/21/1999	07/13/1999	Tested
QA19	814	372	06/21/1999	07/13/1999	
QA20	1679	940	06/21/1999	07/13/1999	
QA21	715	438	06/21/1999	07/13/1999	
QA22	382	303	08/16/1999	08/17/1999	
QA23	1189	615	06/21/1999	07/13/1999	
Total	**24,066**	**15,003**			

Table 6: Madison Park

Node	No. of homes passed	No. of customers	Construction complete	Activation date	Comments
MP15	701	347	09/13/1999	09/14/1999	
MP17	1014	623	09/13/1999	09/14/1999	
MP18	1248	712	09/13/1999	09/14/1999	
MP19	995	482	09/13/1999	09/14/1999	
MP20	566	306	09/13/1999	09/14/1999	
MP21	1482	574	09/13/1999	09/14/1999	Tested
MP22	1049	401	09/13/1999	09/14/1999	
MP23	1035	475	09/13/1999	09/14/1999	
MP24	146	98	09/13/1999	09/14/1999	
MP25	1476	715	09/13/1999	09/14/1999	
MP26	1122	438	09/13/1999	09/14/1999	
MP27	966	444	09/13/1999	09/14/1999	
MP28	1529	674	09/13/1999	09/14/1999	
MP29	1023	372	09/13/1999	09/14/1999	
MP30	1016	419	09/13/1999	09/14/1999	Tested
MP31	1151	476	09/13/1999	09/14/1999	
MP32	1146	493	09/13/1999	09/14/1999	
MP33	1118	444	09/13/1999	09/14/1999	
MP34	1156	479	09/13/1999	09/14/1999	
MP35	1101	578	09/13/1999	09/14/1999	
MP36	906	618	09/13/1999	09/14/1999	
MP37	769	388	09/13/1999	09/14/1999	
MP38	1377	549	09/13/1999	09/14/1999	
MP39	1347	537	09/13/1999	09/14/1999	
MP40	886	462	09/13/1999	09/14/1999	
Total	**26,325**	**12,104**			

Table 7: South Seattle

Node	No. of homes passed	No. of customers	Construction complete	Activation date	Comments
SS17	1267	894	Jul-21-99	Aug-12	
SS18	1745	1,111	Jul-21-99	Aug-12	
SS19	1404	845	Jul-21-99	Aug-12	Tested
SS20	855	527	Jul-21-99	Aug-12	
SS21	1233	633	Jul-21-99	Aug-12	Tested
SS22	317	215	Jul-21-99	Aug-12	
SS23	128	76	Jul-21-99	Aug-12	
SS24	51	32	Jul-21-99	Aug-12	
Total	**7,000**	**4,333**			

Table 8: Georgetown

Node	No. of homes passed	No. of customers	Construction complete	Activation date	Comments
GT01	365	211	Jun-15-99	Jun-17-99	
GT02	284	158	Jun-15-99	Jun-17-99	
Total	**649**	**369**			

3.2 Compliance Verification of AT&T Reports

A total of 162 nodes are evaluated in this report, as shown in Table 1 above. Tables 2 through 8 show the number of customers activated per node and when full service was made available by each node in the West Seattle, Alki, Green Lake, Queen Anne, Magnolia, Madison Park, South Seattle and Georgetown build areas. The nodes highlighted in red were inspected and tested.

3.2.1 Network Reliability and Performance

The criteria used to determine reliability and performance for each audit were built in redundancies for the network equipment and power supply, mean time between failures (MTBF), mean time to repair (MTTR) and overall service availability. We determined a high quality network in terms of reliability and performance during Audit One. However, the maintenance records used for Audit Two (September 1999) and Audit Three (December 1999) show a drop in the reliability and network quality in terms of MTBF and MTTR and service availability.

3.2.1.1 Redundancies

As depicted in the AT&T network architecture, redundancies are built in the system especially at the headend, which is central to the network. The expectation is that any major fault occurring at either of the headends will be restored as soon as possible (usually within seconds) and that outages will be transparent to the customers. Two headends are available and are connected to a self-healing fiber ring, providing redundancy for each other. In addition, eight hubs within the City of Seattle share three secondary fiber rings, providing further redundancy for the network. All the equipment has main and hot standby power.

3.2.1.2 Power Supply

The system at the headend operates on –48 V DC. There is an uninterrupted power supply (UPS) system with battery backup and a standby generator for the headends. The @Home nodes have a separate UPS system.

3.2.1.3. MTBF/MTTR

Mean time between failures (MTBF) and mean time to repair (MTTR) are standard measurements that indicate the quality of the network. The overall availability of the system from January 1999 to December 1999 is 99.9279 percent, equivalent to a system downtime of 379 minutes (6.31 hours). This measurement indicates that from January to December 1999, the total network outage was 6.31 hours. This availability rate indicates an unreliable network. A

reliable network would have greater than 99.9999 percent availability or approximately 0.53 minutes of downtime in one year.

While a MTTR of 1.80 hours is acceptable at present, it is also increasing proportional to the network size. A MTBF of 0.04 months is equivalent to an outage occurring every 28.8 hours for the whole year (1999) and is indicative of poor quality and an unreliable network.

These figures indicate that as AT&T activates more service areas, system reliability and network quality diminish. See Appendix I for copies of AT&T's maintenance report.

3.2.1.4 Maintenance Record Statistics Integrity

The integrity of the data on the maintenance record is questionable. For example in Audit Two we reported a year-to-date service availability of 99.8574 (1121 minutes downtime), MTTR of 1.82 hours and MTBF of 0.03 months for January to September 1999. For the 12 months of 1999, the maintenance records show service availability of 99.9279 (32 minutes), MTTR of 1.80 hours and MTBF of 0.04 months. This indicates that year-to-date figures are not cumulative, and thus are unreliable.

4. Node Testing

Node testing was completed to verify 70 channels node capacity within the 54 to 750 MHz frequency spectrum and 1.5 Mbps downstream and 96 kbps upstream transmission rates.

4.1 Procedure

Nodes tested were randomly selected from testing areas as depicted in Tables 2 through 8 above.

750 MHz capacity verification tests were conducted in the late afternoon or early evening on January 6th, 2000 and February 1st and 18th, 2000. Tests were conducted using a scan graph method, which provides the graph for the full 750 MHz spectrum depicting all 70 channels. Transmission rate tests were conducted during the afternoon and early evening on January 5th, 6th and 20th and February 1st and 15th 2000.

AT&T rescheduled tests several times due to network system problems. Dates tests were rescheduled include January 11th, 14th and 27th, 2000 and February 3rd and 8th, 2000.

The transmission rate of 1.5 Mbps specified in the franchise agreement is equivalent to a full T1 rate. AT&T's network does not provide a dedicated T1 or 1.5 Mbps facilities for every home. Their network is structured to provide equal access for all their customers to all their facilities. Since AT&T lacks the appropriate instruments to test Bit Error Rate (BER) performance of digital cable from outside the customer premise, it is difficult to verify the actual downstream and upstream transmission rates. As an alternative to this test, we used timed file downloads to test the average transmission speed. We believe the file download speed test accurately reflects a customer's experience with the @Home service.

The tests were conducted by an AT&T employee and verified at the site by the auditor. To complete the file download, an AT&T technician chose a file from the @Home site. The auditor chose a file from the Microsoft download site. For both downloads, the auditor recorded the file size in megabytes, and then recorded the total download time from the computer's clock. Since the transmission rate (transfer rate) is in megabits per seconds, the file size in megabytes per second was multiplied by eight to give a transfer rate in megabits/second, i.e. (53.4 megabytes X 8 bits) / 350 seconds = 1.22 megabits/second.

4.2 Nodes Tested

Most of the testing completed for the third audit included both capacity and @Home transmission testing. Four West Seattle nodes were tested for transmission speeds to complete testing in the last audit. Nodes tested are summarized in table 9 below.
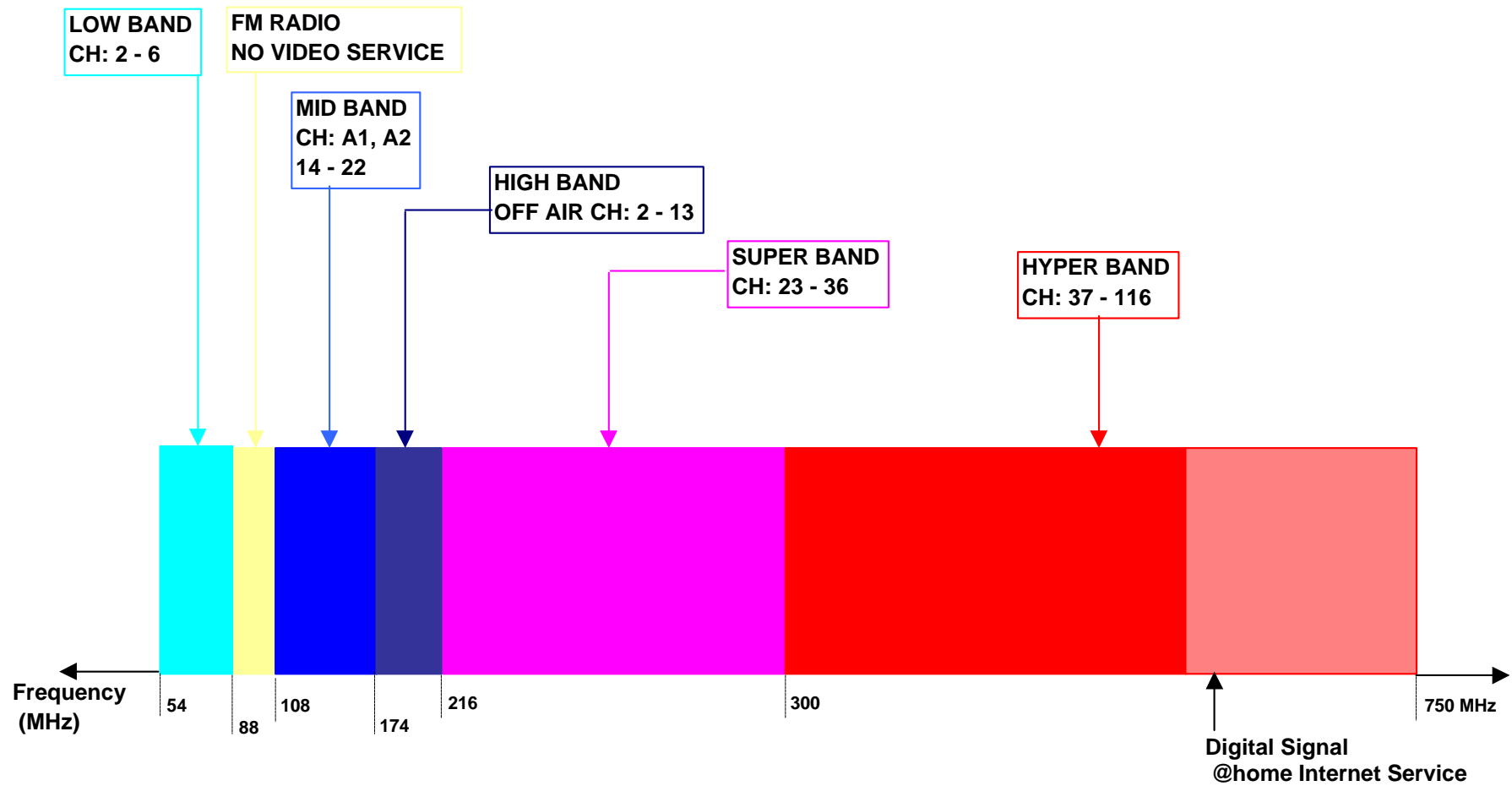
Table 9: Nodes Tested for each Audit

	Tested for 750 MHz spectrum	Tested for Internet transmission speed
Audit One		
West Seattle	WS2, WS13, WS21, WS29, WS48, WS61, WS63	No transmission testing this audit
Green Lake	GL16, GL18, GL20, GL26, GL27, GL30	No transmission testing this audit
Audit Two		
West Seattle	WS54	WS29, WS63 and WS44
Green Lake	GL31, GL39, GL41, GL46, UW18 (GL53)	GL20, GL31, GL39, GL41, GL46, UW18 (GL53)
Audit Three		
West Seattle	Testing completed Audit One & Two	WS13, WS48, WS54, WS61
Green Lake	Testing completed Audit One & Two	GL 26, GL30
Queen Anne, Magnolia	QA12, QA18, MG01, MG10	QA12, QA18, MG01, MG10
Madison Park	MP21, MP 30	MP21, MP 30
South Seattle	SS 19, SS 21	SS 19, SS 21

4.3 Node Capacity Test Results

CATV RF Spectrum is given in Figure 2 to show the frequency range of the spectrum and channel allocation. Figure 2 is an exact replica of the test results of the spectrum. The test results for the area studied show that each node tested has 70 channels capacity within the 54 to 750 MHz spectrum. However, the test results are not as satisfactory as those conducted in other nodes, which were reported in Audit One and Audit Two. The audio channel signals for nodes SS19 and SS-21 are missing. Test results for nodes GL30, GL26, MG01 and MG10 show unwanted signal distortions.

CABLE TELEVISION RADIO FREQUENCY SPECTRUM

**LOW BAND
CH: 2 - 6**

**FM RADIO
NO VIDEO SERVICE**

**MID BAND
CH: A1, A2
14 - 22**

**HIGH BAND
OFF AIR CH: 2 - 13**

**SUPER BAND
CH: 23 - 36**

**HYPER BAND
CH: 37 - 116**

**Frequency
(MHz)**

54   88   108   174   216   300   750 MHz

**Digital Signal
@home Internet Service**

FIGURE 2

NB: Not to scale

4.4 Compliance

4.4.1 750 MHz Node Capacity

The scan graphs in Appendix 2 show that AT&T has met the 750 MHz, 70 channel requirements for the areas tested. From the frequency spectrum graphs, it is apparent that there was interference or distortion to the signals at the time of the testing. The network could not perform satisfactorily under that condition.

4.4.2 Customer Activations

Table 10 summarizes the number of nodes and number of customers activated through September 1999. AT&T has activated a total of 56,045 customers so far this year, meeting the franchise extension ordinance requirements of the total number of customers activated by the end of 1999.[4] The data from AT&T, as replicated in the table below, is located in Appendix 3.

Table 10: City of Seattle Customer Activations

Month Ending 1999	Build areas	No. of nodes	No. of homes passed	No of customers activated	Total activations / month
January					--
February					--
March	BH01.01	2	1502	706	
	GL04	15	16,291	9,341	10,047
April	GL02	9	7,820	4,429	
	GL01	10	9,076	4,267	8,696
May	GL01	1	434	322	
	GL03	2	1,394	1,059	1,381
June	QA03.01	2	2,304	1,517	
	BH01.03	2	649	369	
	GL03	9	5,173	3,344	5,230
July	QA03.02	3	2,962	1,875	
	QA03.01	2	2,304	1,517	
	QA01.02	5	5,537	2,976	
	QA01.03	5	5,182	2,875	9,243
August	QA03.01	1	898	578	
	QA03.02	1	1,248	1,241	
	QA02	1	382	303	
	SS01.01	8	7,000	4,333	6,455
September	QA03.02	3	3,249	2,121	
	MP01.02	25	26,325	12,104	
	QA03.01	1	1,220	768	14,993
Total[5]			**101,582**	**56,045**	**56,045**

---

[4] As per Seattle Upgrade Schedule 62,615 customers were to be activated in 1999. Because AT&T cleaned up its customer database during the year, this figure was reduced to 56,045.

[5] Downtown City Center customer upgrades included 6 nodes, 1281 homes passed and 833 customers activated. West Seattle customer upgrades included 47 nodes, 23,881 homes passed and 15,595 customers upgraded. Alki customer upgrades included 11 nodes, 10,822 homes passed and 6,812 customers upgraded. These number are not included in the total build numbers in table 10 above.

4.4.3 Internet Capability

It is expected that digital signals do not show on the node tests as depicted in Figure 2, where digital signals appear as unused channels after the last video channel within the 54 to 750 MHz spectrum.

4.4.4 Transmission Rates

File transfer rates are summarized in Table 11 and 12. The calculated transfer rate is an average, since the files are transferred at different rates during the download time. Comparing these to Internet dial-up facilities and Digital Subscriber Line (xDSL) services, @Home service is faster in both downstream and upstream. As reported in earlier audits, it was not possible to conduct high-speed performance measurements from outside the customer's home; consequently, the file transfer method adopted was the only option for certification.

From the calculated transfer rates and witnessed downloads, we conclude that AT&T's system has the capability and transmission rates to download large files from the Internet in a shorter period of time than a standard dial-up service. Actual results are included in Appendix 4.

Table 11 Transmission Testing During Audit Two

Node Tested	File Size	Download Time	Calculated Transfer Rate	Date/Time Tested
WS 44[6]	1.4 MB	7 seconds	1.6 megabits/sec	Sat., 8/28/99, 10:30 am
WS 44	47.1 MB	192 seconds	1.96 megabits/sec	Sat., 8/28/99, 10:30 am
GL 39	53.4 MB	350 seconds	1.22 megabits/sec	Fri., 10/8/99, 5:00 pm
GL 46	53.4 MB	360 seconds	1.19 megabits/sec	Fri., 10/8/99, 5:30 pm
GL 20	23.2 MB	150 seconds	1.24 megabits/sec	Tues., 10/12/99, 2:30 pm
GL 31	23.2 MB	159 seconds	1.17 megabits/sec	Tues., 10/12/99, 6:45 pm
GL 41	23.2 MB	146 seconds	1.27 megabits/sec	Tues., 10/12/99, 3:45 pm
UW 18[7]	32.8 MB	200 seconds	1.31 megabits/sec	Tues., 10/12/99, 4:40 pm
WS 63	23.2 MB	76 seconds	2.44 megabits/sec	Tues., 10/12/99, 5:00 pm
WS 29	23.2 MB	71 seconds	2.61 megabits/sec	Tues., 10/12/99, 5:30 pm

---

[6] Node tests for WS 44 were conducted during a test session. The auditors did not collect a print screen of the download, but only noted file sizes and download times.
[7] GL 53

Table 12   Transmission Testing During Audit Three

Node Tested	File Source	File Size	Download Time	Calculated Transfer Rate	Date/Time Tested
	@Home site[8]	17.3 MB	52 seconds	2.66 megabits/sec	
	MS download[9]	47 MB	150 seconds	2.50 megabits/sec	
WS 54	MS download	47 MB	180 seconds	2.08 megabits/sec	Wed., 1/5/00, 4:00 pm
	@Home site	17.3 MB	45 seconds	3.07 megabits/sec	
WS 13	MS download	47 MB	105 seconds	3.58 megabits/sec	Wed., 1/5/00, 5:00 pm
	@Home site	17.3 MB	50 seconds	2.76 megabits/sec	
WS61	MS download	47 MB	180 seconds	2.08 megabits/sec	Wed., 1/5/00, 5:00 pm
	@Home site	17.3 MB	44 seconds	3.14 megabits/sec	
WS48	MS download	47 MB	165 seconds	2.27 megabits/sec	Wed., 1/5/00, 5:00 pm
	@Home site	22 MB	99 seconds	1.77 megabits/sec	
GL30	MS download	47 MB	250 seconds	1.50 megabits/sec	Thurs., 1/6/00, 3:00 pm
	@Home site[10]	22 MB	137 seconds	1.28 megabits/sec	
MG01	MS download	47 MB	315 seconds	1.19 megabits/sec	Thurs., 1/6/00, 3:00 pm
	@Home site	22 MB	142 seconds	1.23 megabits/sec	
MG10	MS download	47 MB	290 seconds	1.29 megabits/sec	Thurs., 1/6/00, 3:00 pm
	@Home site[11]	53.5 MB	280 seconds	1.52 megabits/sec	
GL26	MS download	47 MB	327 seconds	1.14 megabits/sec	Thurs., 1/20/00, 2:30 pm
	@Home site	53.5 MB	285 seconds	1.50 megabits/sec	
QA12	MS download	47 MB	970 seconds	0.38 megabits/sec	Thurs., 1/20/00, 4:00 pm
	@Home site	53.5 MB	280 seconds	1.52 megabits/sec	
QA18	MS download	47 MB	262 seconds	1.43 megabits/sec	Thurs., 1/ 20/00, 4:30 pm
	@Home site[12]	95.1 MB	680 seconds	1.11 megabits/sec	
SS19	MS download	47 MB	300 seconds	1.25 megabits/sec	Tues., 2/1/00, 4:00 pm
	@Home site	95.1 MB	380 seconds	2.00 megabits/sec	
SS21	MS download	47 MB	205 seconds	1.83 megabits/sec	Tues., 2/1/00, 5:00 pm
	@Home site[13]	31.8 MB	111 seconds	2.29 megabits/sec	
MP30	MS download	47 MB	222 seconds	1.69 megabits/sec	Tues., 2/15/00, 3:00 pm
	@Home site	31.8 MB	226 seconds	1.08 megabits/sec	
MP21	CNet download[14]	27 MB	200 seconds	1.08 megabits/sec	Tues., 2/15/00, 4:00 pm

4.4.5 Contention Rate

The 3% contention rate stipulated in the Franchise Agreement could be neither tested nor verified. Contention is defined as "a condition that occurs when several devices [modems] are vying for access to a line and one of them can get it at a time." [15]

---

[8] Shanghi Game downloaded from: http://www.home.com
[9] Age of Empires II downloaded from: http://www.microsoft.com/downloads
[10] Tread Mark downloaded from: http://www.home.com
[11] Battle Cruiser downloaded from: http://www.home.com
[12] Soldier of Fortune downloaded from: http://www.home.com
[13] Croc 2 downloaded from http://www.home.com
[14] Battlezone downloaded from http://www.cnet.com

AT&T maintains that contention is irrelevant as their network is available to all customers at any time without blocking (access denial). AT&T contends that customers are only denied access to the service during a system outage.

---

[15] Newton's Telecom Dictionary: The Official Dictionary of Telecommunications, Harry Newton, Flatiron Publishing, 14th Updated and Expanded Edition, Copyright, 1998.

5. Service Availability

This section of the audit evaluates the expanded programming services available to AT&T customers. Specifically, the audit evaluates whether or not AT&T has upgraded its cable TV service to offer 70 channels of programming and to offer @Home Internet service throughout the Queen Anne, Magnolia, Madison Park and South Seattle build areas.

5.1 Survey Methodology

To evaluate service availability, the auditors conducted telephone interviews with 31 AT&T and @Home customers. A sample interview lot was randomly selected from AT&T's customer list of over 1000 customers located throughout Queen Anne, Magnolia, Madison Park and South Seattle. Every fourth customer was called until at least four customers in each zip code were interviewed. Customers interviewed live in ZIP codes 98102, 98108, 98109, 98112 and 98118.

Twenty-four interviews were completed with cable TV customers and twenty-four interviews were completed with @Home customers. All interviews were conducted between February 5th and February 18th, 2000. A copy of the survey questions is available in Appendix 5.

It should be noted that the ranking criteria used in Audits Two and Three is different from the criteria used in Audit One. In Audits Two and Three a "5" is the highest possible score while a "1" was the worst score.

The survey conducted for this portion of the audit is qualitative and therefore its results are not statistically significant and cannot be projected into the overall population of cable TV and @Home subscribers in Seattle.

5.2 Survey Findings

5.2.1 Cable TV

Most customers interviewed currently receive AT&T's upgraded expanded basic cable TV service with 70 channels. Customers interviewed either subscribe to the expanded basic service or the digital cable service. Twenty-four interviews were completed for the cable TV portion of the questionnaire. A quantitative summary of the survey results is available in Appendix 6.

Overall, customers were fairly satisfied or highly satisfied with their cable TV service. Almost all customers gave an average to high satisfactory rating for program content and variety. However, twenty-five percent of customers have serious video reception problems. Customer service scores ranged from average to high with representatives scoring higher for a professional attitude than for their service knowledge.

5.2.1.1 Programming Evaluation and Service Quality

Programming

Customers rated AT&T's cable TV service program content and variety between average and high. Eight of twenty-four customers gave program content a rating of 3, while eleven gave it a higher score of 4 or 5. Scores for variety of programming were similar. Comments for improvement included more channel selection and not paying for channels you do not watch.

Not many customers responded to the question regarding the on-screen menu, but those who did ranked the service from average to high. Unsatisfied customers complained that the guide was not convenient because they had to scroll through the digital channel menu before viewing the expanded basic selection.

Customers ranked video and audio quality high, although one quarter of customers were less satisfied with the video quality because of poor channel reception on one or several channels. One customer mentioned that some channels were consistently "fuzzy". Another customer has requested attention to poor video quality, but after several attempts, AT&T still has not solved the problem. A third customer, with a new television set, has bad reception quality only on channel eleven.

Service Disruption

Almost all of the customers interviewed have experienced service disruption less than ten percent of the time while using AT&T expanded basic cable service. Most customers commented that their service was disrupted only once or twice and that disruptions seemed to be weather related.

5.2.1.2 Customer and Repair Service Evaluation

Customer Service

One-half of customers who answered the cable TV questions have called AT&T cable TV Customer Service at least once. All customers needed to speak with a live person to answer their question or resolve their problem.

Survey participants ranked AT&T's cable TV customer service average to high in terms of courteous and professional attitude and knowledge. Customer service representative did receive higher scores with regard to courteous and professional attitude and received more average scores for knowledge level.

Most customers waited less than 2 minutes to speak with someone at AT&T Customer Service. Six customers waited less than thirty seconds to speak with someone. No customers have ever received a busy signal.

Repair Service

Sixteen customers have placed an on-site installation or repair request with AT&T and the work was completed in either less than three days (five customers), between three days and one week (six customers), or over a week (five customers).

Customer Rebates

Two-thirds of customers interviewed that were eligible for the upgrade reported not receiving customer rebates on their cable bill or did not remember receiving a rebate. No customer indicated that they had called AT&T to find out why they had not received a rebate. Only five of twenty-four customers recalled receiving a rebate on their bill.

5.2.2 @Home

Twenty-four interviews were completed with customers living in Queen Anne, Magnolia, Madison Park and South Seattle for the @Home portion of the questionnaire. Twenty percent of customers interviewed have had service three months or less, sixty percent have had service between four and six months, and twenty percent have had service for more than six months.

Results for the @Home service were fairly positive with respect to speed of service. Scores for immediate and uninterrupted access were slightly lower. Customers overwhelmingly gave the e-mail service a poor rating.

Interviewees ranked customer service representative and installers highly in terms of courteous and professional attitude, but felt that the knowledge level for representatives and installers should be higher or much higher. Finally, customers wait too long to speak with a representative that could solve their problem.

5.2.2.1 Quality of the @Home service

Speed and Access

Almost all customers indicated that, compared to a regular telephone line, the @Home service is meeting their expectations for speedy Internet access. Twenty-two of twenty-four customers gave speed either a 4 or a 5 satisfaction ranking. Only two customers thought that the @Home service should provide faster access. Rankings of speed for video clips were similar.

Customers were also generally pleased with their ability to access the service immediately. However, three customers were extremely displeased with accessing the service and gave low scores of 1 and 2.

None of the users that subscribe to both @Home and AT&T cable TV have experienced problems accessing the Internet while the TV is on.

Functionality

The e-mail service was the biggest issue for many of the customers interviewed. More than one-third of customers gave a score of 1 or 2 when ranking e-mail. A few customers wanted to give a 0 ranking. One such customer complained that the service "keeps going down and that it takes

days to get a response." Another customer said that e-mail is not accessible at least twice a week. This individual also commented that the e-mail is difficult to read because of the formatting. Finally, one customer says that e-mail is down up to one week at a time. Other disgruntled customers had similar complaints.

Most customers interviewed never tried accessing the @Home e-mail account remotely. In fact, many customers did not know about the option to use remote @Home e-mail. Those that have tried using the service remotely have been successful.

Most customers have not used the @Home search engine enough to comment. One-third of customers that have used the search engine were moderately to highly satisfied.

Speed as Advertised

Twenty of twenty-four customers said that the @Home service meets their expectations for speed and that the service seems to be, as advertised, 20 to 100 times faster than a regular phone line. Only three customers were not currently satisfied with the speed of access. One customer had not previously used a dial-up connection and could not compare the services.

About one-half of customers indicated that Internet service is slower during the early evening between 6:00 p.m. and 10:00 p.m. A few people noted that service is slower during working hours (from 9 a.m. to 5 p.m.).

5.2.2.2 Quality of Installation, Customer Service and Repair Service

In general, customers ranked AT&T customer service highly for installation, customer and repair service; however, customers felt that they waited too long to speak with a customer service representative and not all customer service representatives or installers scored highly in terms of knowledge.

Installation

Most customers interviewed were pleased with the overall installation experience. Comments ranged from good to excellent. Customers gave technicians high scores for professional and friendly attitude as well as for knowledge. Five customers did not characterize the installation experience as favorably as the majority did. These five customers had mixed experiences. Some had an installer that did not know basic wiring or did not have adequate PC knowledge but that was pleasant. Others had a bad experience during the initial installation, but a much better experience with a second installer.

Most of the installations were completed on time as scheduled. One customer waited several weeks for his installation to be completed.

Customer Service and Repair Service

Most customers (seventeen of twenty four) have called @Home or AT&T Customer Service with a question or to report a problem. Some customers did not find the @Home service number readily available. Only one customer called AT&T instead of @Home. Three customers received a busy signal when calling @Home Customer Service.

All customer problems and requests required speaking with a customer service representative to reach resolution. Most customers (fourteen of seventeen) had to wait on hold longer than two minutes to speak with someone. Of those that waited longer than two minutes, seven waited anywhere between five and twenty minutes, three waited about one half hour to an hour, and two waited over two hours. One customer that waited an hour on hold also waited twenty-four hours for a call back. One customer suggested that @Home indicate how long the wait will be when a person is holding.

When customers spoke with customer service representatives, they mostly found courteous, professional staff. More customers ranked customer service representatives higher in terms of courteous and professional attitude than in terms of knowledge. While one third of customer gave @Home representatives a high score of 5 for knowledge, another third gave them an average score of 3 and the final third ranked them a 1 or 2.   Customers that ranked @Home lowly had ongoing problems and were doubtful of ever having them resolved.

5.2.2.3 Customizing the @Home Service

One half of the customers interviewed use the @Home home page. Some of those same customers use an alternate page as their home page. The other half of the customers uses their own home page, a work page, Yahoo!, Netscape, MSN, etc. Most of the customers said it was fairly easy to change the @Home page to another default page. One or two commented that it was a little difficult to figure out at first, but that they finally did.

Only five of twenty-four customers interviewed have or have used another Internet Service Provider (ISP) with their @Home service. Customers that do use another ISP use America Online (AOL).

6. Conclusion

6.1 Technical Evaluation

The AT&T network upgrade is complete in the City of Seattle. The two headends on the fiber ring plus other redundancies built in to the network provide survivability and reliability for the cable TV and @Home services. The areas tested have 70 TV channels with full-expanded programming within the 54 to 750 MHz frequency spectrum. AT&T has activated 56,045 customers as of the end of December 1999 meeting the requirement under the franchise extension ordinance.

The technical evaluation for both spectrum testing and network reliability revealed some potential problems with the network. Firstly, the engineering auditor found spectrum distortions at four nodes and missing audio components of the spectrum at two nodes. Secondly, the reliability figures given in the maintenance record indicate that AT&T's network expansion affected network reliability. The overall availability of the system from January 1999 to December 1999 is 99.9279 percent, equivalent to a system downtime of 379 minutes (6.31 hours). With the network upgrade behind AT&T in 2000, we would expect an availability of 99.9999 percent.

Results of transmission speeds were similar Audit Two results. Downloading files on the @Home service proved faster than both traditional dial-up and DSL service. Upstream transmission is also faster using the @Home service.

6.2 Service Evaluation

As with the West Seattle and Green Lake build areas, AT&T appears to be in compliance with the franchise extension ordinance in terms of expanded service offerings in the Queen Anne, Magnolia, Madison Park and South Seattle build areas. Customers have access to about 70 channels with AT&T's expanded basic cable TV service and also have high-speed Internet access through @Home.

Customer satisfaction of AT&T cable TV service is ranked between average and high. The survey results from the third audit interviews are similar to those conducted in the West Seattle and Green Lake for Audits One and Two.

Customers have had an average to fairly good experience with AT&T cable TV service, yet most would agree that improvements could be made to the service. Customers were pleased with the attitude of the customer service personnel, with short telephone wait times, few busy signals, infrequent service interruptions, and fairly quickly scheduled installations. It is worth mentioning that customers waited longer to schedule installations in Green Lake, Queen Anne, Magnolia, Madison Park and South Seattle than they did in West Seattle; however, a delayed installation period did not seem to frustrate customers as much as other issues have.

Most customer dissatisfaction stems from ongoing problems with indefinite resolution such as video reception quality or under qualified customer service representatives. For instance, many customers have consistently poor reception on a few particular channels. Many of these customers have lost hope that the problem will ever be resolved and now have lower expectations for total service quality. Finally, while AT&T representatives receive high rankings for being courteous and professional, they received lower rankings for knowledge. Customers often felt that their questions were not answered adequately or that problems were never resolved. One customer commented that the representative was "nice but could not answer the question." Other customers acknowledge that the level of expertise of representatives varies depending on who answers the phone.

The @Home service also received mixed reviews by customers. Unlike the Green Lake customers interviewed in September that had uniformly new subscriptions to the service, customers in Queen Anne, Magnolia, Madison Park and South Seattle have had service anywhere from a few weeks to over six months.

Overall, the survey results to Audit Three were similar to the West Seattle and Green Lake results: when the service is working, subscribers are extremely pleased. When the service is no7t functioning as expected, and especially when customer service is inadequate, customers become frustrated. In general, customers are much more willing to accept shortcomings in service when the operator communicates effectively with its customers. AT&T seems to be inconsistent in terms of both communication with customers and the ability to solve service issues.

On the positive side, most customers were satisfied with the speed of the @Home service, ranking it far above a regular dial-up service. Unlike with Green Lake customers, Queen Anne, Magnolia, Madison Park and South Seattle residents had more immediate access to @Home.

AT&T seems to have curtailed system-wide network outages since the Green Lake audit when more customers complained of limited, inconsistent or no access. Most interviewees rated the installation experience highly. Customer service representatives were considered professional and courteous. Busy signals were rare. Customers found it easy to change the @Home page or to use another ISP, typically AOL, over the @Home cable when they tried.

This audit revealed similar frustration levels with e-mail access as the previous audit did for immediate and uninterrupted access and the West Seattle audit did for speed. In addition to difficulty with e-mail, customers felt unattended by customer service. Problems included: not getting access at all, not receiving incoming e-mails, and not having consistent access to e-mail. All of these customers felt that AT&T had left them in the dark by not communicating and by letting the problem continue for days, weeks or months.

Suggestions included more frequent communication during network outages or e-mail problems. A few customers recommended posting notices of e-mail server problems and estimated duration of such problems on the @Home home page or on the customer service outgoing telephone message. Others thought they should receive a rebate for not having unlimited access to the service.

Customers also had trouble determining who to call for questions about their @Home service. Some customers spent up to three hours waiting on the phone for an answer to their question. Many customers think AT&T should invest in training or more knowledgeable customer service representatives to improve the service provided and to decrease the time it takes to get an answer.

AT&T rolled-out the @Home service at record speeds over the last year. This speedy roll-out may not have given AT&T time to perfect the network to achieve more optimal levels of performance. The good news is that, despite a rapid rollout, the majority of customers are fairly pleased with the service. The not-so-good news is that there is a strong minority, sometimes up to one-third of customers interviewed, that is extremely displeased. If AT&T can maintain fewer service glitches, improve communication and foster a stronger customer focus, they might keep these customers satisfied--particularly in the face of rising competition for the City of Seattle's local broadband market.

6.3 Recommendations

AT&T should examine the data collection method and interpretation of the outage statistics.

AT&T should retest nodes SS19 and SS21 to ensure that the audio component is present. They should also retest the other nodes to determine whether or not the signal distortion persists.

AT&T should measure the contention rate as specified in the original franchise agreement with the City of Seattle.

AT&T should increase communication with customers regarding general network and service outages as well as specific customer complaints. Customers are more likely to be satisfied when they receive timely and informative notifications and responses.

7. Acknowledgements

We would like to thank the following AT&T personnel for providing the necessary logistics and records, and for participating in the node testing during this and the two previous audits.

- Chris Clemens
- Douglas Cooper
- Tony Speller
- Mark Wojciechowski
- John Reid

8. Appendices

Appendix 1 - Maintenance Records

Appendix 2 - Node Capacity Test Results

Appendix 3 – Customer Activation

Appendix 4 - Transmission Test Results

Appendix 5 - Service Availability Questionnaire

Appendix 6 – Summary of Survey Results